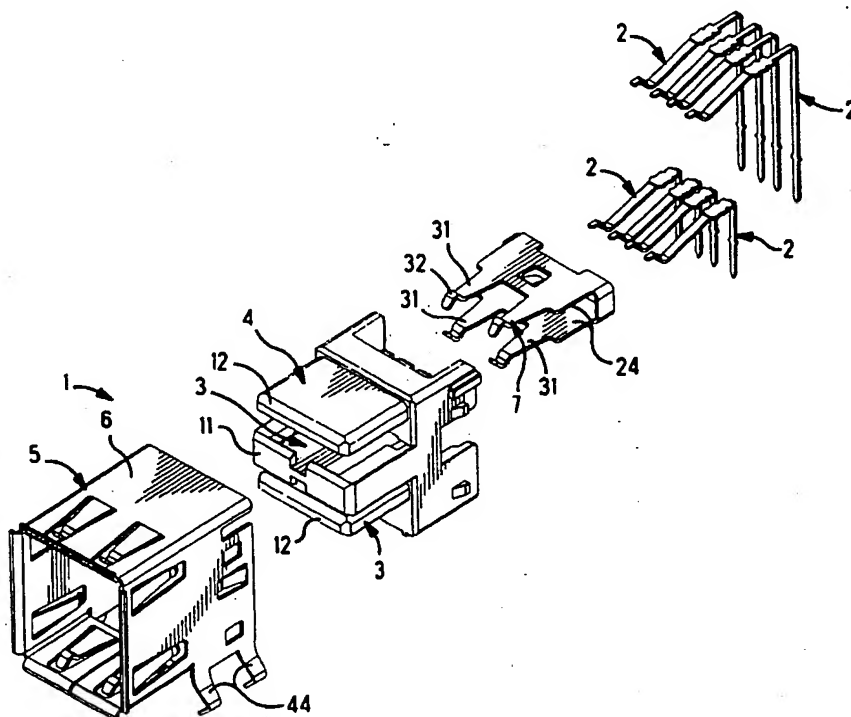




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: <b>PCT/US96/14774</b> (22) International Filing Date: <b>16 September 1996 (16.09.96)</b> (30) Priority Data: <b>60/003,852</b> <b>15 September 1995 (15.09.95)</b> <b>US</b> (71) Applicant: <b>THE WHITAKER CORPORATION [US/US];</b> <b>Suite 450, 4550 New Linden Hill Road, Wilmington, DE</b> <b>19808 (US).</b> (72) Inventors: <b>DAVIS, Wayne, Samuel; 4108 N. 6th Street,</b> <b>Harrisburg, PA 17110 (US). WHITEMAN, Robert, Neil, Jr.;</b> <b>1031 Plane Street, Middletown, PA 17057 (US). SHIRK,</b> <b>Michael, Eugene; 255 North Crawford Road, Grantville, PA</b> <b>17028 (US).</b> (74) Agents: <b>FRANCOS, William, S. et al.; The Whitaker Corpora-</b> <b>tion, Suite 450, 4550 New Linden Hill Road, Wilmington,</b> <b>DE 19808 (US).</b>		(81) Designated States: <b>CN, JP, KR, SG, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</b>  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: SHIELDED ELECTRICAL CONNECTOR



## (57) Abstract

A shielded electrical connector having an insulating housing (4), a conducting outer shell (6) encircling the housing (4), and a conducting second or inner shell (7) engaging the outer shell (6) to provide electrical shielding (5), electrical contacts (2) extending inside multiple plug receiving cavities (3) in the housing (4), the second shell (7) extending inside each of the plug receiving cavities (3) to engage plug type connectors to be received in the plug receiving cavities (3).

SHIELDED ELECTRICAL CONNECTOR

The invention relates to a shielded electrical connector, and more particularly, to a shielded  
5 electrical connector with a shielding shell that encircles an insulating housing.

Each of US-A-5,161,999, and US-A-5,167,531 discloses a shielded connector assembly constructed with two electrical headers for connection to plug type  
10 electrical connectors. Two shells encircle respective headers to provide shielding. The headers and the two shells are mounted to a conducting bracket. A third shell mounts on the bracket and covers a rear of each of the headers. This connector assembly is bulky, because  
15 of a relatively large number of separate parts, comprising a mounting bracket, two headers, two shells encircling respective headers, and a third shell. It would be desirable to provide an electrical connector comprising multiple plug receiving cavities, wherein  
20 each of the plug receiving cavities is encircled by shielding, and wherein the connector is comprised of a reduced number of separate parts to achieve a compact size.

US-A-5,387,114 discloses a shielded electrical  
25 connector comprising a conducting outer shell encircling an insulating housing, and a conducting second shell engaging the outer shell. Electrical contacts are received inside respective cavities in the housing. The second shell extends along slots in the housing; the  
30 slots are beside the cavities without being inside the cavities, with portions of the housing separating the slots from the cavities. These housing portions prevent the second shell from engaging portions of a mating plug type connector that are to be inserted inside the  
35 cavities for mating with the contacts therewithin.

It would be desirable to provide an electrical connector with an improved compact size that is achieved

by a shield extending inside multiple plug receiving cavities to engage respective plugs that are to mate with electrical contacts inside the cavities.

The invention pertains to a shielded electrical connector, a compact size of which is achieved by extending a conducting shell inside multiple plug receiving cavities to engage respective plugs that are to mate with electrical contacts inside the cavities. The invention is constructed with a reduced number of parts, as compared with prior electrical connectors, thereby simplifying assembly and reducing fabrication costs.

An advantage of the invention resides in shielding that completely encircles multiple plug receiving cavities, the shielding comprising a second shell engaging an outer shell, the second shell extending inside the multiple plug receiving cavities to achieve a compact construction.

According to an embodiment of the invention, a shielded electrical connector comprises an insulating housing, a conducting outer shell encircling the housing, and a conducting second shell engaging the outer shell to provide electrical shielding, electrical contacts extending inside multiple plug receiving cavities in the housing, the second shell extending inside each of the plug receiving cavities to engage electrical plug type connectors to be received in the plug receiving cavities.

A preferred embodiment will now be described with reference to the accompanying drawings, according to which:

FIGURE 1 is an isometric view of an electrical connector with parts being separated from one another;

FIGURES 2 and 3 are isometric rear and front views of the connector shown in FIG. 1;

FIGURE 4 is a side view in section of the connector shown in FIG. 1, together with two mating plug type electrical connectors shown in dotted outlines;

FIGURE 5 is an isometric view of an insulating housing that is a part of the connector shown in FIG. 1;

FIGURE 6 is an isometric view of a second shell that is a part of the connector shown in FIG. 1;

FIGURE 7 is an isometric view of a rear of the housing that is shown in FIG. 5;

FIGURES 8 and 9 are isometric views of conductive electrical contacts that are part of the connector shown in FIG. 1;

FIGURE 10 is an isometric view of a rear of the housing shown in FIG. 5, together with the contacts shown in FIGS. 8 and 9;

FIGURE 11 is an isometric view of a front of a conductive outer shell that is a part of the connector shown in FIG. 1;

FIGURE 12 is a top view in section of the connector shown in FIG. 1 illustrating the second shell in a plug receiving cavity of the housing; and

FIGURE 13 is a top view in section of the connector shown in FIG. 1 illustrating a row of contacts in a plug receiving cavity of the housing.

With reference to FIGS. 1-4, an electrical connector 1 comprises two rows of electrical contacts 2 inside respective plug receiving cavities 3 in an insulating housing 4, and shielding 5 comprising a conducting outer shell 6 encircling the housing 4 and a conducting second shell 7 inside the outer shell 6 and inside the plug receiving cavities 3. For example, the connector 1 is shown as having two plug receiving cavities 3. As shown in FIG. 4, in phantom or dotted outlines, respective electrical plug connectors 8 are to be inserted into respective plug receiving cavities 3 to mate with the connector 1. Each of the plug connectors 8 comprises, a conductive shell 9 projecting from an

insulating overmold 10. Although not illustrated, it should be understood that each of the plug connectors 8 further comprises, an insulating housing surrounded by the shell 9, and electrical mating contacts in the housing to be inserted into respective plug receiving cavities 3 of the connector 1 to engage and electrically connect with the contacts 2 in the connector 1. General construction of a mating electrical plug connector 8 is described in US-A- 5,017,156 and in US-A-5,267,882.

With reference to Figs. 5, 7 and 10, the housing 4 is of unitary, molded plastic construction. A partition 11 on the housing projects forwardly between the two plug receiving cavities 3 with opposite sides thereof facing respective plug receiving cavities 3. The cavities 3 have similar constructions, with the construction of one of the cavities 3 being inverted with respect to the construction of the other of the cavities 3. Second partitions 12 parallel to the partition 11 divide respective plug receiving cavities 3 into two parts, each of the cavities being divided into a shell receiving cavity section 13 and a contact receiving cavity section 14.

With reference to FIGS. 8 and 9, the electrical contacts 2 will be described. Each of the contacts 2 is of unitary construction, stamped and formed from metal. A cantilever spring 15, formed with a curved contact portion 16, extends forwardly from an elongated terminal 17 that is bent downward. The terminal 17 on the contact 2 shown in FIG. 8 is relatively longer than a relatively shorter terminal 17 on the contact 2 shown in FIG. 9. A widened mounting section 18 rearward of the spring 15 has barbed edges. A widened mounting section 19 on the terminal 17 has barbed edges.

With reference to FIGS. 7 and 10, multiple contact receiving passages 20 project forwardly from a rear of the housing and are arranged in an upper row and a lower row. A widened slot 21 extends across a top of each of

the passages 20. The longer contacts 2 project through respective passages 20 in the upper row while the shorter contacts 2 project through respective passages 20 in the lower row. The widened sections 18 on the  
5 contacts 2 are wedged in respective slots 21 to restrain the contacts 2 from movement.

Beneath each row of passages 20, a corresponding contact spacer plate 22 projects rearwardly from a remainder of the housing 4. Elongated terminal  
10 receiving slots 23 communicate with a rear of each of the contact spacer plates 22. The slots 23 in an upper one of the plates 22 are aligned with respective slots 23 in a lower one of the plates 22. The terminals 17 of the contacts 2 project rearwardly from respective  
15 passages 20 and project downwardly and through corresponding slots 23. The shorter terminals 17 of the contacts 2 project through corresponding slots 23 in the lower plate 22 while the longer terminals 17 project through slots 23 in both plates 22. Thus, each slot 23  
20 in the lower plate 22 receives two terminals 17. Thereby the terminals 17 are aligned by the plates 22 for mounting in apertures through a circuit board, not shown. The widened section 19 on each terminal 17 is wedged in a corresponding slot 23 in the lower plate 22  
25 to restrain the terminal 17 from movement.

With reference to FIGS. 4 and 13, the curved contact portions 15 on respective electrical contacts 2 extend along the passages 20. The passages 20 open into respective plug receiving cavities 3, forming  
30 grooves along respective partitions 12. The contact portions 15 extend along the grooves, facing into the contact receiving cavities 14.

With reference to FIGS. 4, 6, 10 and 12, the conducting second shell 7 is of unitary construction,  
35 stamped and formed from a sheet of metal that has a thickness plane, forming the thickness plane of the second shell 7. The second shell 7 comprises spaced

apart plates 24 that connect at bent corners 25 with respective webs 26 that extend transversely of the plates 24. An open seam 27 separates one of the webs 26 from a corresponding plate 24. The plates 24 fit  
5 slidably along spaced apart slots 28, FIGS. 4 and 7, in the housing 4. The slots 28 extend in the housing 4 from rear to front. As shown in FIG. 2, the second shell 7 is forward of the upper row of terminals 17 on the contacts 2. Thus, the second shell 7 is assembled  
10 to the housing 4 before such contacts 2 are assembled to the housing 4. Cantilever latch fingers 29 project rearwardly on each plate 24, being struck out of the thickness plane of the plates 24. The latch fingers 29 are deflected resiliently when the plates 24 are  
15 inserted along the spaced apart slots 28, and spring outwardly when they have entered respective slots 28. The latch fingers 29 face toward a rear wall 30, FIGS. 4 and 12, in each of the slots 28 to restrain rearward movement of the second shell 7 relative to the housing  
20 4.

The plates 24 on the second shell 7 fit slidably over, and register along, the partition 11 on the housing 4. Further, the plates 24 on the second shell 7 extend on the opposite sides of the partition 11.  
25 Cantilever spring fingers 31 project forwardly from each plate 24. The spring fingers 31 on the second shell 7 project forwardly of the plates 24, and extend in respective plug receiving cavities 3 to engage respective plug type electrical connectors 8 to be  
30 received in the plug receiving cavities 3. Each of the spring fingers 31 has a curved tip 32 that projects into a corresponding trough 33 recessed in the partition 11. The tips 32 extend along a corresponding plug receiving cavity 3 to engage respective plug type electrical  
35 connectors 8 to be received in the plug receiving cavities 3. The spring fingers 31 on the second shell 7 extend in respective plug receiving cavities 3 together

with the electrical contacts 2 in each of the plug receiving cavities 3, whereby plug type electrical connectors 8 to be received in the plug receiving cavities 3 will be engaged by the spring fingers 31 on the second shell 7, and by the electrical contacts 2.

With reference to FIG. 4, each plug 8 will enter a corresponding contact section 14 to engage the contacts 15 in a corresponding row of the contacts 15. The conducting shell 9 on the plug connector 8 will enter both the contact section 14 and a corresponding shell receiving section 13 of the same plug receiving cavity 13.

With reference to FIGS. 2, 3, 11 and 12, the conducting outer shell 6 is of unitary construction. stamped and formed from a sheet of metal that has a thickness plane, forming the thickness plane of the outer shell 6. The outer shell 6 comprises four walls 34 that are joined together at bent corners 35 with one of the walls 34 bifurcated by an open seam 36. The four walls 34 encircle an open front end on the outer shell, and outwardly turned lips 37 on respective walls 34 are adjacent the open front end.

The housing 4 and the outer shell 6 are latched together by a latch 38, FIGS. 2 and 3, that comprises openings 39 in corresponding walls 34 on the outer shell 6 receiving projecting wedge shaped projections 40 on the housing 4. The projections 40 are inclined in a direction from front to rear, such that the projections 40 can be urged into the open rear end of the outer shell 6, and latch in the openings 39 in corresponding walls 34.

Slotted openings 41, FIGS. 2 and 3, extending from rear to front in corresponding opposite walls 34 communicate with the open rear end on the outer shell 6. Elongated ribs 42 projecting from the housing 4 on opposite walls extend along the slotted openings 41 to prevent pivoting of the outer shell 6 relative to the



housing 4. The ribs 42 enter the slotted openings 41 from the rear when the housing 4 is inserted into the open rear end.

5 The four walls 34 on the outer shell 6 encircle an open rear end on the outer shell 6. The wall 34 that is bifurcated by the seam 36 has a rear opening 43, FIG. 11. Instead of removing metal to form the opening 43, the metal that would have been removed to form the opening 43 becomes elongated electrical terminals 44  
10 that are in alignment with the opening 43. The terminals 44 are connected to, and project from, corresponding opposite walls 34. The terminals 44 are for connection in openings through a circuit board, not shown, on which the connector 1 is to be mounted. A  
15 shoulder 45, FIGS. 4 and 5, on the housing 4 faces forwardly and is received in the opening 43 to resist forward movement of the housing 4 relative to the outer shell 6. The housing 4 is inserted into the open rear end of the outer shell 6 until the shoulder 45 faces an  
20 edge on the opening 43.

Spring fingers 46 on each of the four walls 34 on the outer shell 6 are adjacent the open front end of the outer shell 6. Each of the spring fingers 46 is a cantilever beam with a curved tip 47 that projects  
25 inside the outer shell 6. The spring fingers 46 on corresponding opposite walls 34 extend from front to rear. The spring fingers 46 on a remainder of the corresponding opposite walls 34 extend from rear to front. Each of the spring fingers 46 is bent out of the  
30 thickness plane of the outer shell 6 to project inwardly of the walls 34. With reference to FIG. 4, the spring fingers 46 on the bifurcated wall 34 face toward and extend along a corresponding plug receiving cavity 3, along the contact receiving section 14. The spring  
35 fingers 46 on an opposite wall 34 is received in a shell receiving section 13 of the other plug receiving cavity 3, which shell receiving section 13 is between the outer

shell 6 and a corresponding outer wall on the housing 4. As shown in FIGS. 4 and 13, the shell receiving recess 13 extends over lateral sides on each of the partitions 12. The spring fingers 46 on each of the two walls 34 that join the bifurcated wall 34, extend along the shell receiving recess 13, in turn, that extends over lateral sides on each of the partitions 12. The spring fingers 46 engage the shells 9 on respective plug connectors 8, when the plug connectors 8 are received in the plug receiving cavities 3 to mate with the connector 1. Thus, electrical connection is advantageously established by engagement of the outer shell 6 and the second shell 7 with each other, as well as to each shell 9 on a plug connector 8.

With reference to FIGS. 2, 3, 10 and 12, the second shell 7 bridges across recesses 48 in the housing. The outer shell 6 projects into the recesses 48 and engages the second shell 7. More particularly, additional spring fingers 49 on respective walls 34 on the outer shell 6 are adjacent the rear end of the outer shell 6 and are similar in construction as compared with the spring fingers 46. The additional spring fingers 49 on the outer shell 6 project into the recesses 48 in the housing 4 to engage respective webs 26 on the second shell 7 whereby the second shell 7 engages the outer shell 6 and establishes an electrical connection therebetween.

An advantage of the invention resides in shielding that completely encircles multiple plug receiving cavities, the shielding comprising a second shell engaging an outer shell, the second shell extending inside the multiple plug receiving cavities to achieve a compact construction.

Another advantage resides in shielding comprising: a second shell engaging outer shell, wherein both the outer shell and the second shell extend in respective multiple plug receiving cavities of a connector,

enabling both the outer shell and the second shell to engage respective electrical plug connectors to be received in the plug receiving cavities.

WHAT IS CLAIMED IS:

1. A shielded electrical connector (1) of the type having an insulating housing (4), electrical contacts  
5 (2) extending inside multiple plug receiving cavities (3) in the housing, and a conducting outer shell (6) encircling the housing, characterized in that:

a conducting second shell (7) is secured within the housing (4) and engages the outer shell (6) to  
10 provide electrical shielding, the second shell (7) extending inside each of the plug receiving cavities (3) to engage plug type connectors (8) to be received in the plug receiving cavities (3).

2. A shielded electrical connector (1) as recited  
15 in claim 1 wherein, the second shell (7) fits slidably over a partition (11) on the housing (4), the partition (11) being between said plug receiving cavities (3), and the second shell (7) registers along both sides of the partition (11).

20 3. A shielded electrical connector (1) as recited in claim 1 wherein, spring fingers (31) on the second shell (7) extend in respective plug receiving cavities (3) together with the electrical contacts (2) in each of the plug receiving cavities (3), whereby plug type  
25 electrical connectors (8) to be received in the plug receiving cavities (3) will be engaged by the spring fingers (31,46) of the second and outer shells (6,7) and by the electrical contacts (2).

30 4. A shielded electrical connector (1) as recited in claim 1 wherein, spaced apart plates (24) on the second shell (7) fit slidably in spaced apart slots (28) in the housing (4), webs (26) on the second shell extend transversely of the plates (24), the webs bridge across recesses (48) in the housing (4), and spring fingers  
35 (49) on the outer shell (6) project into the recesses (48) and engage the webs (26).

5. A shielded electrical connector (1) of the type having an insulating housing (4), at least two plug receiving cavities (3) in the housing, electrical contacts (2) in each of the plug receiving cavities, and  
5 a conductive outer shell (6) encircling the housing (4), characterized in that:

a conductive second shell (7) is secured within the housing (4) and engages the outer shell (6), and the second shell (7) projecting between the plug receiving  
10 cavities (3) in the housing (4), whereby each of the plug receiving cavities is encircled by the shielding.

6. A shielded electrical connector (1) of the type having an insulating housing (4), plug receiving cavities (3) in the housing to receive respective plug  
15 type connectors (8), a conductive outer shell (6) having respective walls (34) encircling the housing and encircling an open front end on the outer shell, and first spring fingers (46) on said respective walls (34), the first spring fingers (46) being adjacent the open  
20 front end on the outer shell (6) to engage respective mating plugs (8) to be inserted inside the outer shell (6), characterized in that:

a conductive second shell (7) is secured within the connector inside the outer shell (6) and has first  
25 spring fingers (31) adjacent an open front end of the outer shell, the second shell (7) being inside respective plug receiving cavities (3) to engage respective plug type connectors (8) to be inserted into the respective plug receiving cavities (3), and second  
30 spring fingers (49) on the outer shell (6) engaging the second shell (7) to establish an electrical connection therebetween.

7. A shielded electrical connector (1) as recited in claim 6 wherein, a partition (12) in each plug  
35 receiving cavity (3) divides each plug receiving cavity into a shell receiving section (13) and a contact receiving section (14).

8. A shielded electrical connector (1) as recited in claim 7 wherein, some of the first spring fingers (46) extend into one of the contact receiving sections (14) of the plug receiving cavities (3), and a remainder  
5 of the first spring fingers (31) extend into respective shell receiving sections (13) of the plug receiving cavities (3).

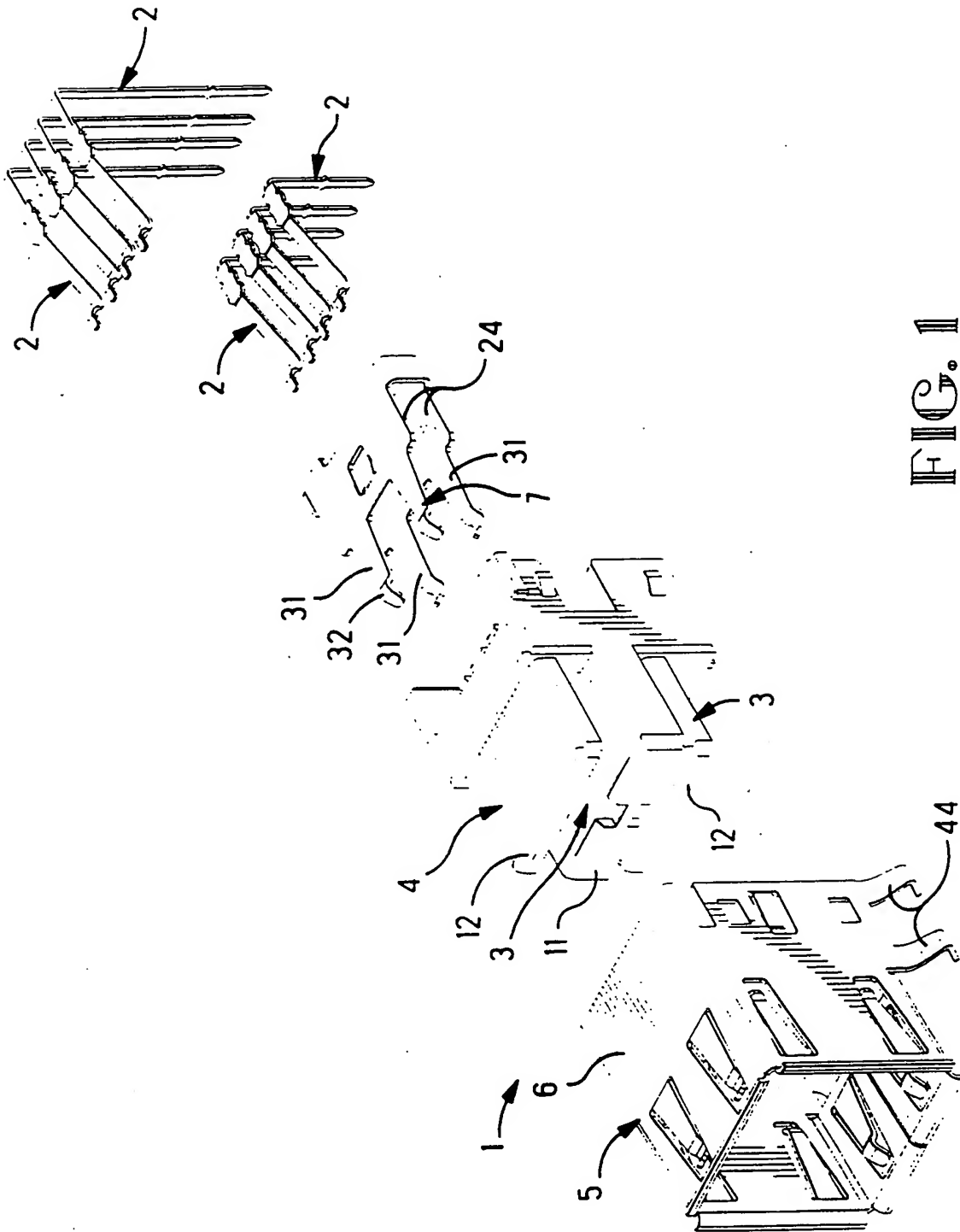
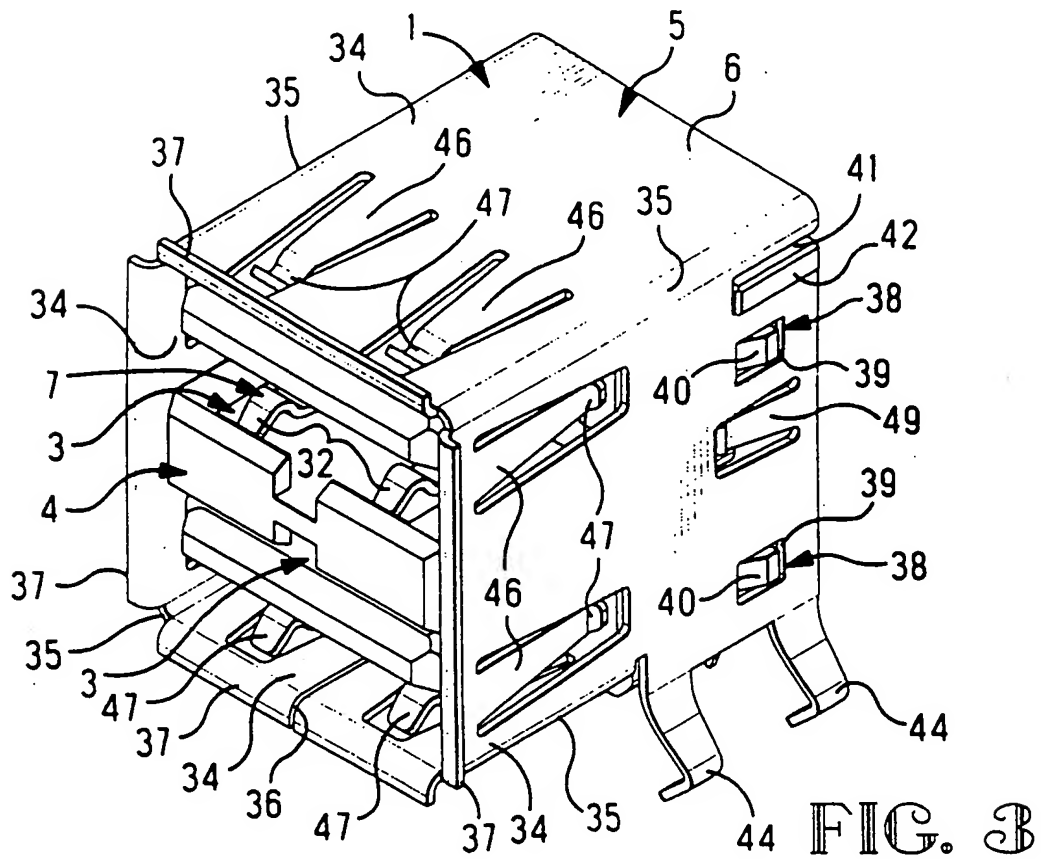
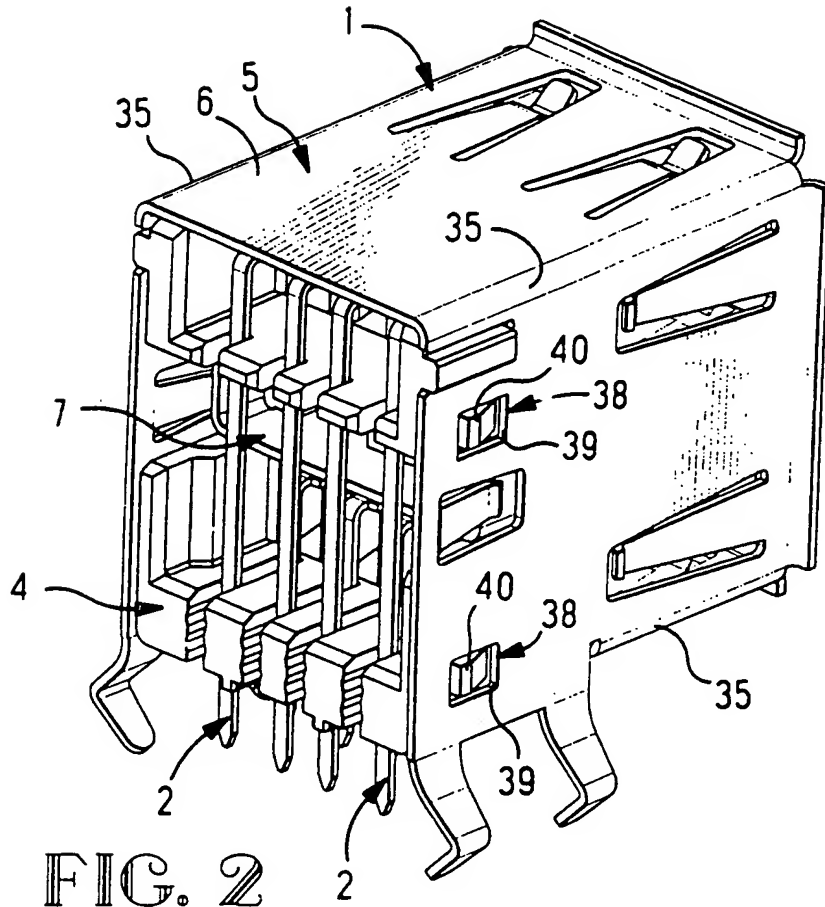
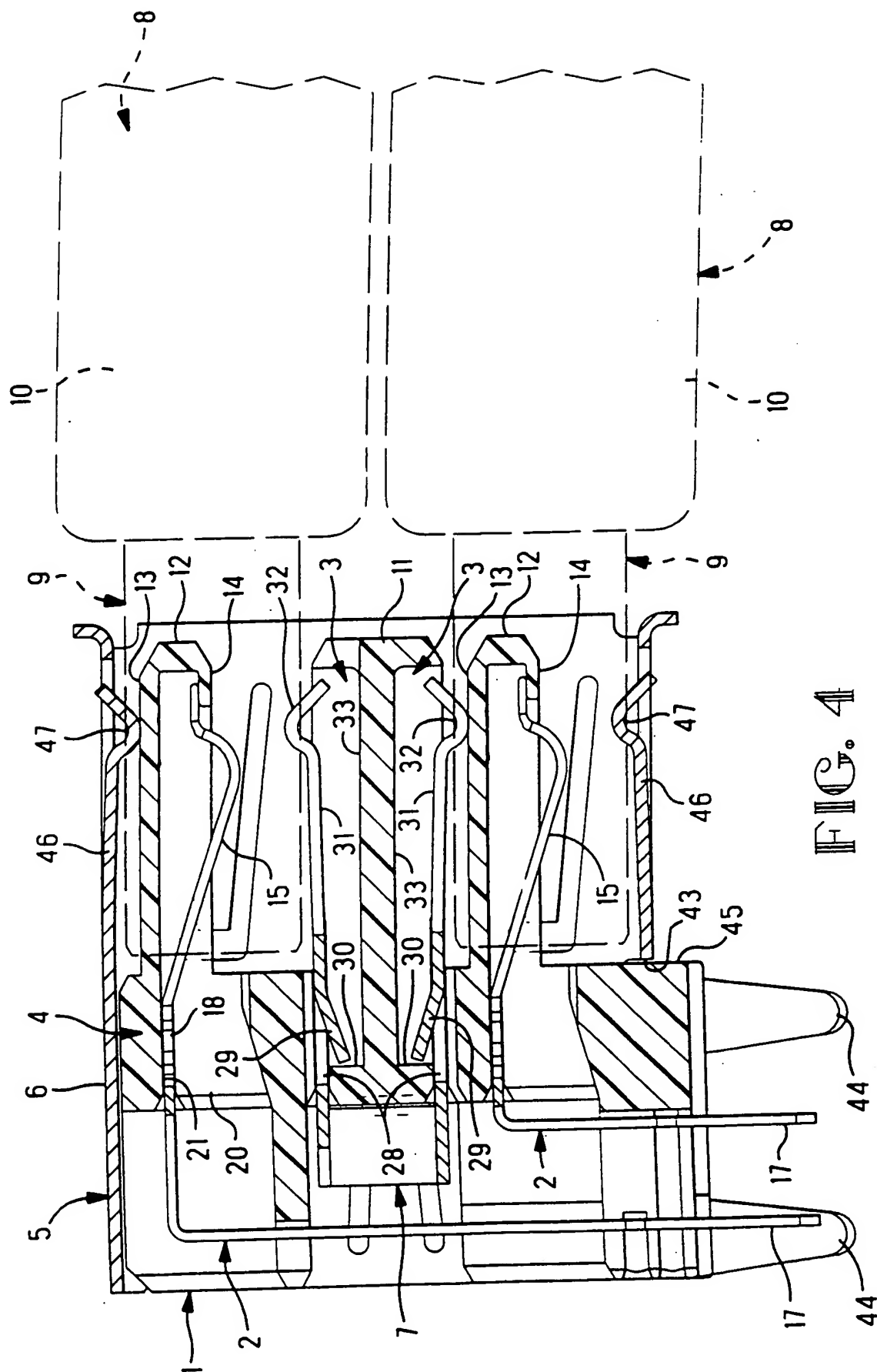


FIG. 1







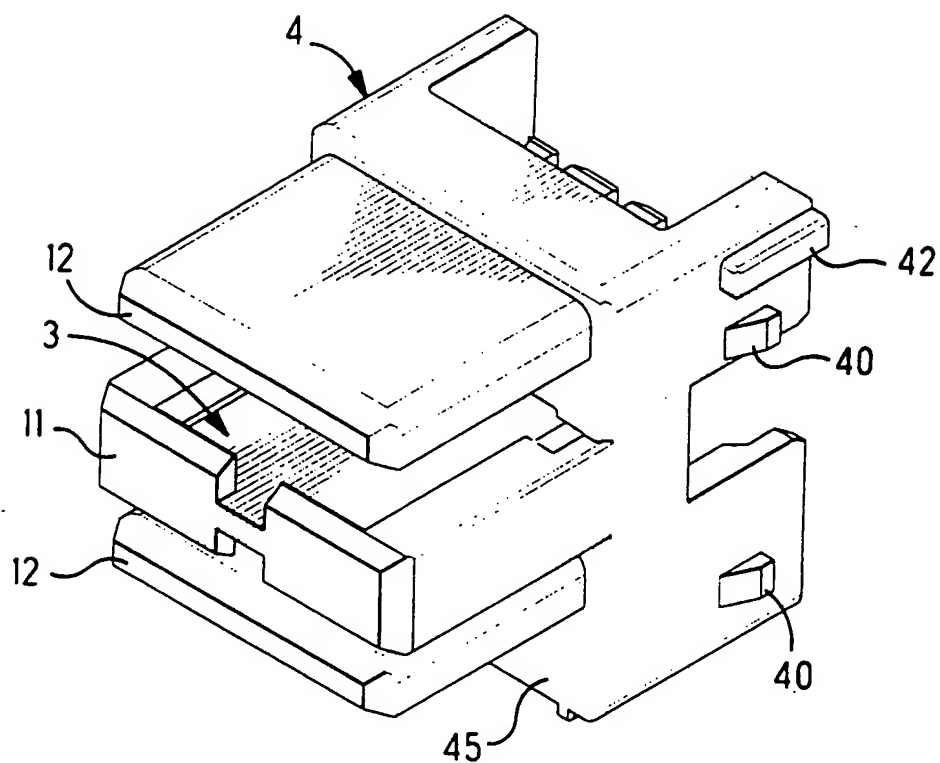


FIG. 5

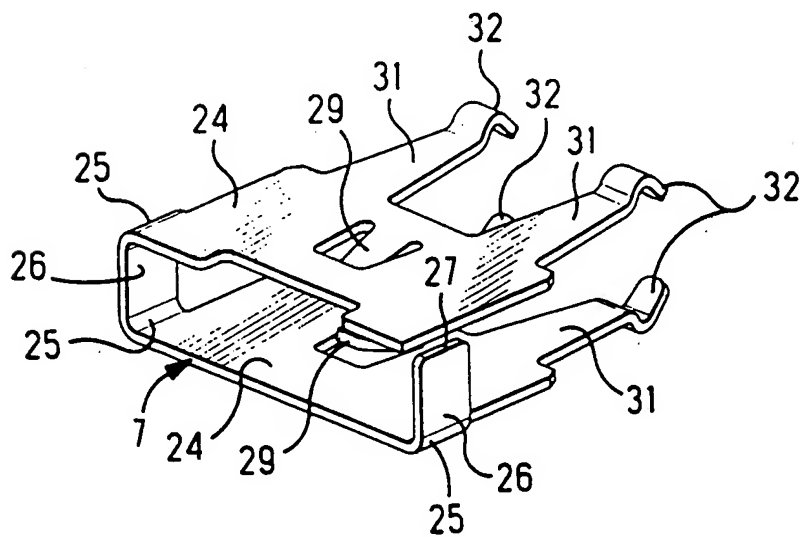


FIG. 6

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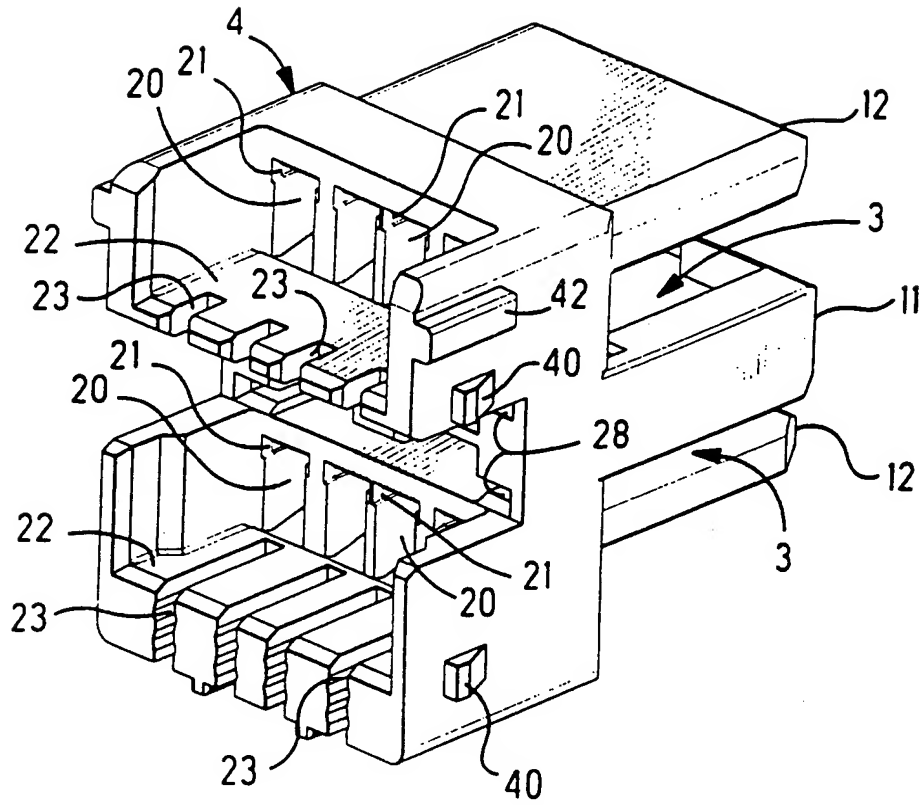


FIG. 7

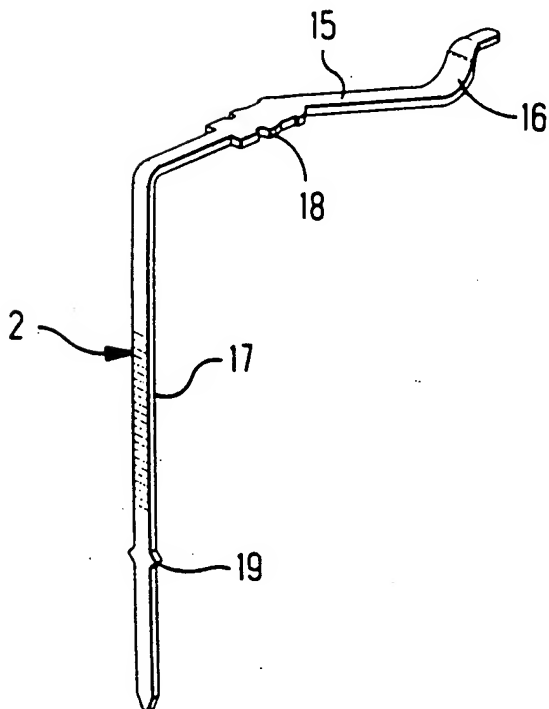


FIG. 8

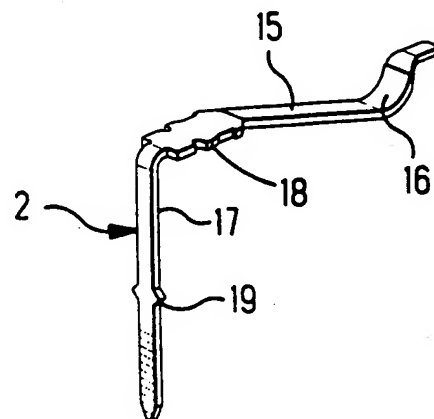
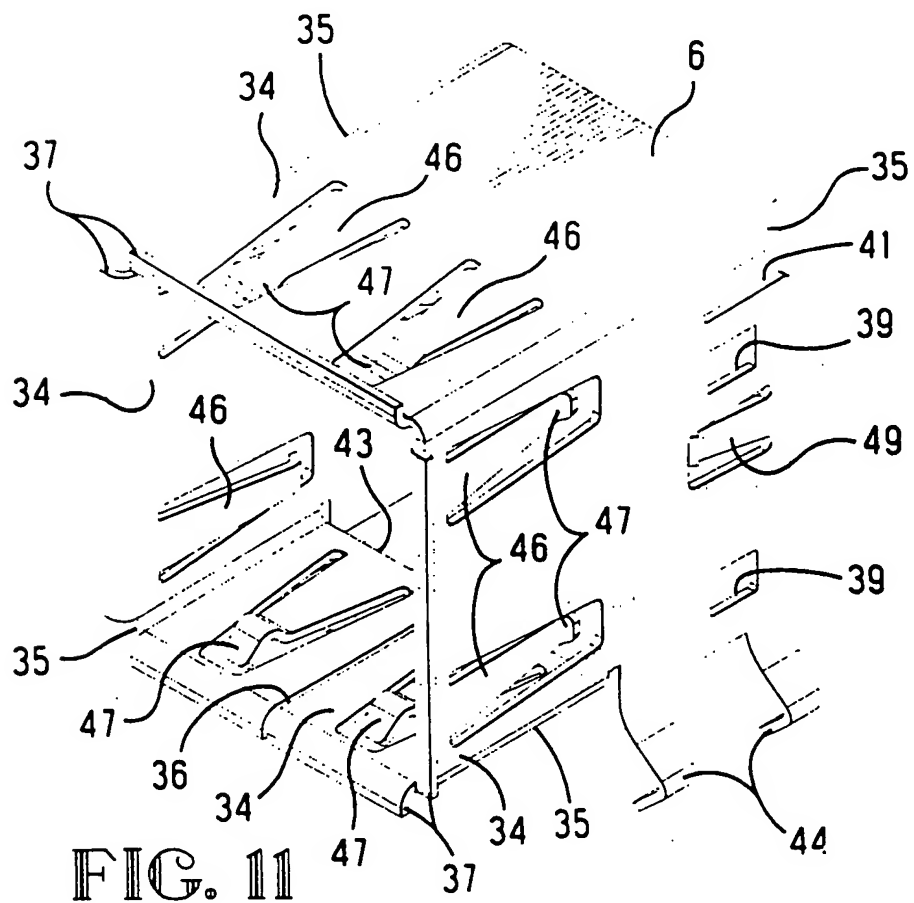
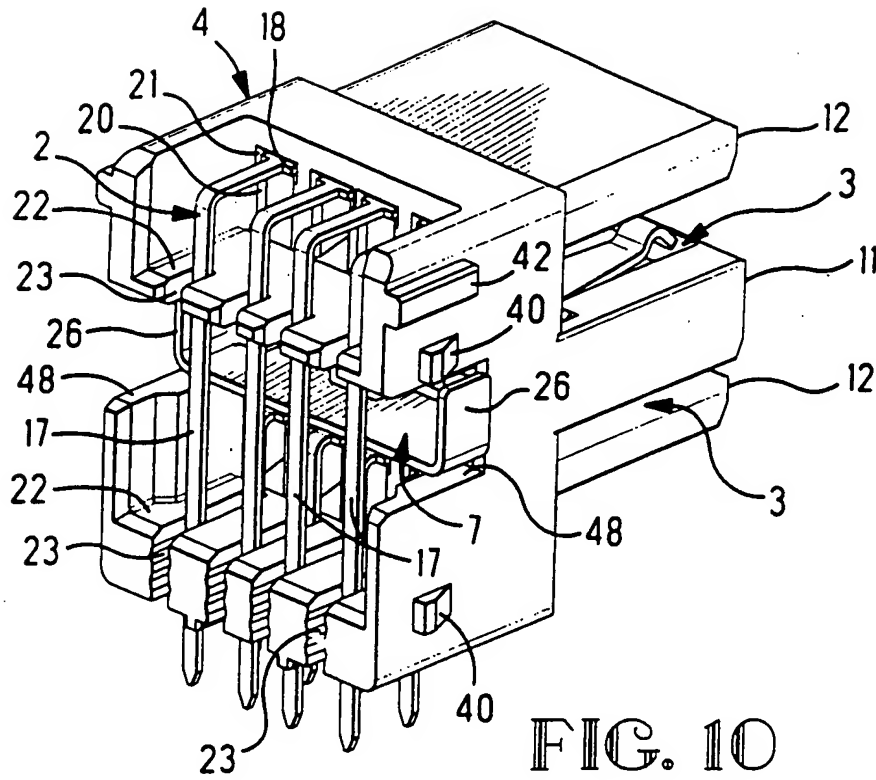
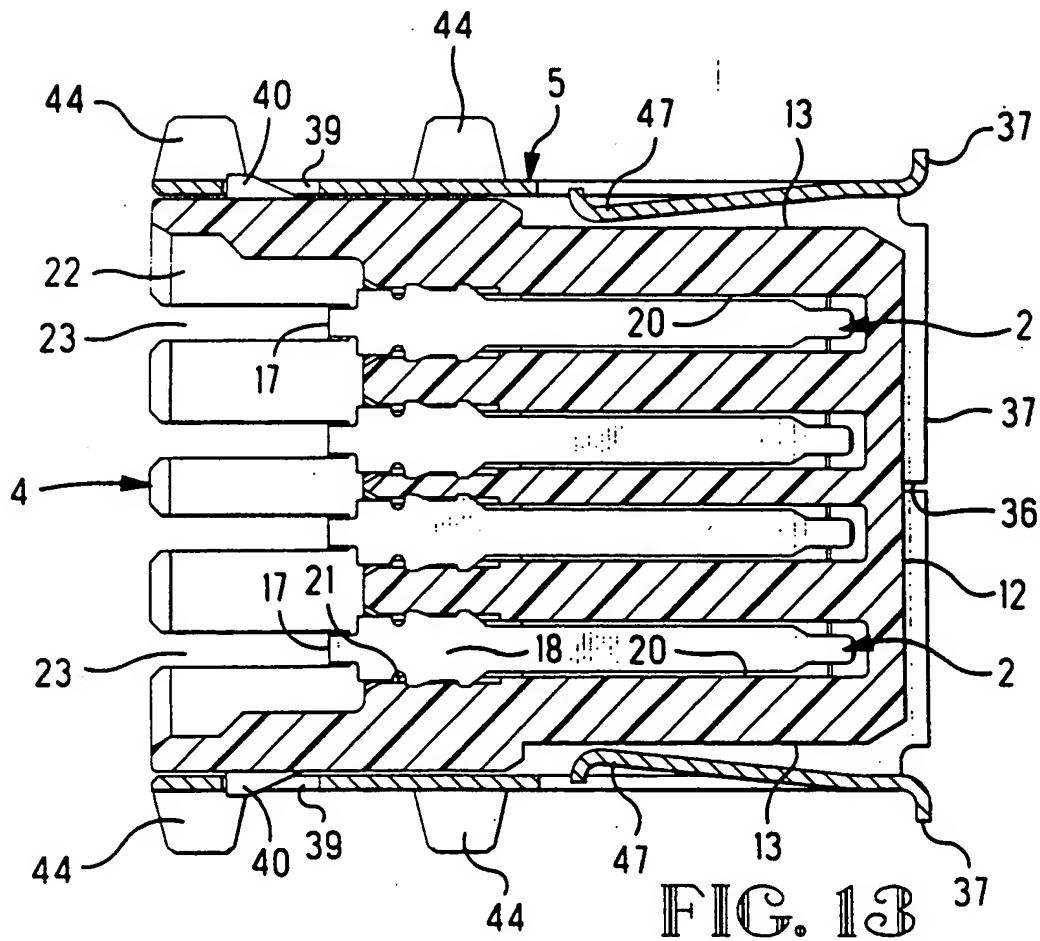
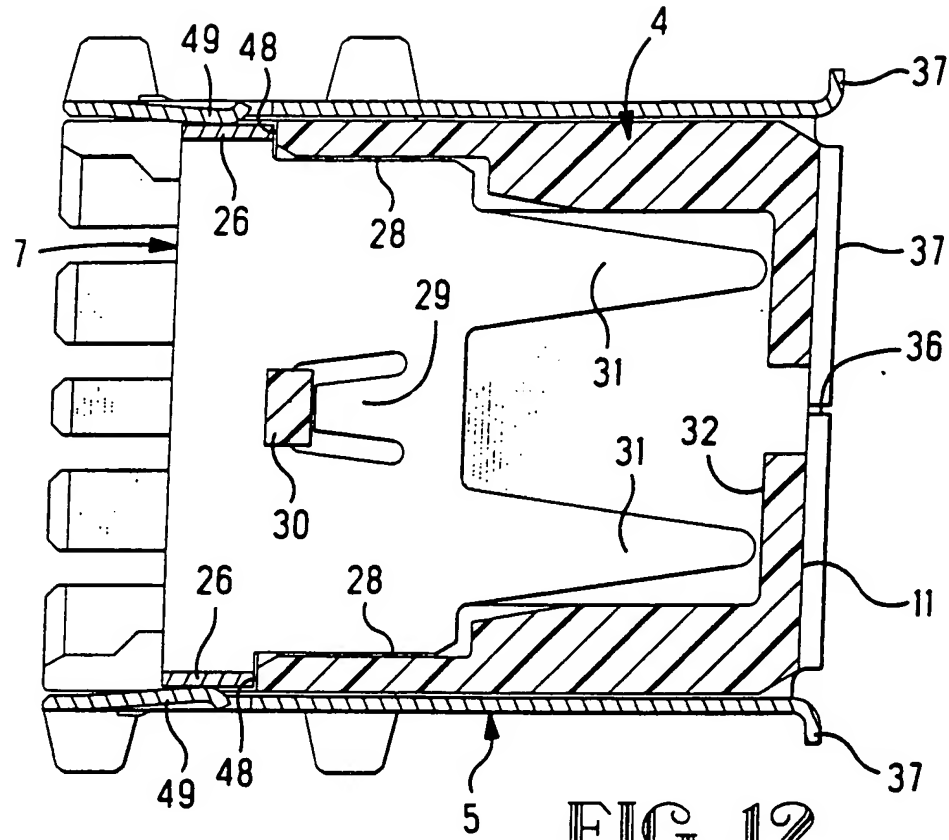


FIG. 9





# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 96/14774

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 H01R23/68

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US,A,5 399 105 (KAUFMAN JOHN W ET AL) 21 March 1995	1
A	see abstract; claims; figures 2,3	2-8
Y	EP,A,0 455 367 (AMP INC) 6 November 1991	1
A	see abstract; claims; figures 4-9	2-8
A	EP,A,0 268 441 (DU PONT) 25 May 1988	1-8
A	see abstract; claims; figures	
A	EP,A,0 514 055 (FUJITSU LTD) 19 November 1992	1-8
A	see abstract; claims; figures 1-3,6	
A	US,A,5 085 590 (GALLOWAY MICHAEL D) 4 February 1992	1
	see abstract; figures	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

15 January 1997

Date of mailing of the international search report

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Name and mailing address of the ISA  
European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. Application No

PC/US 96/14774

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-5399105	21-03-95	WO-A- 9530259	09-11-95
EP-A-0455367	06-11-91	CN-A- 1056382	20-11-91
		DE-D- 69120347	25-07-96
		US-A- 5114355	19-05-92
EP-A-0268441	25-05-88	CA-A- 1289211	17-09-91
		DE-D- 3789089	24-03-94
		DE-T- 3789089	14-07-94
		US-A- 5169324	08-12-92
		AU-B- 607444	07-03-91
		AU-A- 8128187	19-05-88
		JP-A- 63158766	01-07-88
		US-A- 4824383	25-04-89
		US-A- 5057028	15-10-91
EP-A-0514055	19-11-92	JP-B- 2528234	28-08-96
		JP-A- 5135826	01-06-93
		KR-B- 9512469	18-10-95
		US-A- 5195899	23-03-93
US-A-5085590	04-02-92	NONE	